Superfund Research Program

The Superfund Research Program (SRP) supports practical research that creates benefits, such as lower environmental cleanup costs and reduced risk of exposure to hazardous substances, to improve human health. SRP funds colleges, universities, and small businesses, including the Duke University Superfund Research Center (Duke SRC), to advance this work across the nation.

Research Highlights

Developmental sensitivity to insecticides

Infants and children exposed to environmental contaminants early in life can have health effects that last into adulthood.

Duke SRC researchers found that a drug used to prevent premature delivery and help protect premature infants' lungs may make them more likely to develop neurobehavioral problems when also exposed to insecticides, and that these effects may continue later in life.[1] The drug dexamethasone, a type of steroid, is given to approximately 400,000 infants each year, and to pregnant women at risk of delivering prematurely.[2]

Theodore Slotkin, Ph.D., and his team exposed rats to dexamethasone during pregnancy, and then exposed their offspring to the insecticide chlorpyrifos, which is used on agricultural crops in nearly 100 countries and the U.S. The offspring had worsened neurobehavioral outcomes than rats exposed to either the steroid or the insecticide alone. The neurobehavioral effects were observed in adolescent and adult rats, even though exposure had been stopped at infancy.[1] These data suggest that children exposed to dexamethasone prenatally or as infants may be especially sensitive to the toxic effects of environmental contaminants. The results add to the growing evidence that environmental exposures during childhood can have lasting effects, even into adulthood.

Studying how fish thrive in polluted waters

Duke SRC researchers determined that embryos from fish living in contaminated waters are resistant to the toxic effects of chemicals that typically cause developmental defects in fish.[3] Richard Di Giulio, Ph.D., leads a team that is studying killifish living in the area of the Elizabeth River that is part of the Atlantic Wood Industries Superfund site in Portsmouth, Virginia.[4] The site is heavily contaminated with polycyclic aromatic hydrocarbons (PAHs), which are known to cause cancer and birth defects in animals.[5] When treated with different developmental toxicants, embryos from fish in more highly contaminated waters had fewer heart malformations than fish from less contaminated waters.[3] Researchers are striving to understand how these fish have adapted to the contaminated waters, in order to explore ways to prevent toxicity in animals and humans.

Duke SRC graduate students Daniel Brown and Audrey Bone collect killifish at the Atlantic Wood Industries Superfund site for further research. (Photo courtesy of Duke SRC)

Duke UNIVERSITY

Duke SRC collaborative researchers seek to understand how early-life exposures to toxic chemicals may alter development and lead to health issues later in life. They study how pesticides, PAHs, and flame retardants impact brain development, thyroid function, and more. They are also developing new strategies to clean up hazardous waste sites.

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Using nanoparticles and bacteria to clean up contaminated water

Duke SRC researchers found that iron nanoparticles can help bacteria clean up a wide variety of toxic chemicals in water at contaminated sites. Mark Wiesner, Ph.D.; Claudia Gunsch, Ph.D.; and Heileen Hsu-Kim, Ph.D., reported that iron-containing nanoparticles increased the breakdown of toxic chemicals when added to a water treatment system. This system relies on bacteria to help break down the chemicals, and the nanoparticles make the process more efficient.[6]

The importance of studying developmental toxicants

- Pesticides, like chlorpyrifos, are widely used in agriculture worldwide. Early-life exposure has been associated with neurobehavioral and other health effects.[7]
- PAHs are highly toxic chemical mixtures that are created when products like oil, coal, and garbage are burned. PAHs are found in air, soil, and foods, especially grilled or charred foods.[6]

Research overview

- Studying how exposures to pesticides, PAHs, flame retardants, and other chemicals interfere with normal brain development and metabolism. (Theodore Slotkin, Ph.D., t.slotkin@duke.edu)
- Identifying ways that embryos from fish living in highly contaminated water resist the toxic effects of PAHs. (Richard Di Giulio, Ph.D., richd@duke.edu)
- Developing strategies to use nanomaterials and bacteria to treat contaminated sediments and water. (Mark Wiesner, Ph.D., wiesner@duke.edu)
- Measuring exposures to flame retardants and identifying health effects. (Heather Stapleton, Ph.D., heather.stapleton@duke.edu)

Sharing results

Duke SRC connects with government agencies, industry professionals, community organizations, K-12 teachers, and other partners to bring information and research results about environmental health and toxic exposures to the public. Underserved communities are a particular focus. (Charlotte Clark, Ph.D., cclark@duke.edu)

Other contributions to advance science

- The Duke SRC research support facility provides vital access to expertise, research resources, and state-of-the-art instrumentation for its research projects. (Heather Stapleton, Ph.D., heather.stapleton@duke.edu; Edward Levin, Ph.D., edlevin@duke.edu)
- The Duke SRC integrated, multidisciplinary training experience provides early-career scientists access to teams of diverse professionals and encourages innovation to develop solution-oriented approaches to complex environmental health problems. (Edward Levin, Ph.D., edlevin@duke.edu)

NIEHS Grant Number:

P42ES010356

Grant Period: 2000-2016

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Legislative Authority:

Section 311(a) of the Superfund Amendments and Reauthorization Act (SARA) of 1986

For more information on the National Institute of Environmental Health Sciences, visit **www.niehs.nih.gov**.

For more information on the Superfund Research Program, visit **www.niehs.nih.gov/srp**.

For more information on the Duke University Superfund Research Center, visit **http://sites.nicholas.duke.edu/superfund**.

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